

Wilshire question 1

[What is the] incremental impact [of commodity futures (CFs)] on total fund return and risk?

CalPERS response**RETURNS**

Returns summary. Staff concludes that Fund expected return would be essentially unaffected by an investment in CFs, a conclusion premised on the following:

- The forecast CF annual return is 6.5%, between forecast equity and bond returns, and
- Funding for CFs would be from both equities and bonds.

Returns discussion. Forecasting returns for CFs is particularly difficult, as the anticipated CF insurance premium is small relative to total return volatility. As an analogy, it is difficult to forecast an equity premium because it is dwarfed by the volatility of equity returns over short periods.

Skeptics of CFs assert that the time period for which CF returns data are available, particularly since 1970 for the energy-dominant GSCI, was an unusually favorable period for CFs, thus one unlikely to reoccur. We have three responses:

- 1) The same argument could be made that high equity returns particularly since 1982 also resulted from an unusually favorable environment for equities, thus prior and prospective equity returns are lower than actual returns in recent decades, yet we continue to invest 2/3 of Fund assets in equities,
- 2) Returns for the Gorton and Rouwenhorst equal-weighted CF index since 1959 are now available. These returns, 10.5% annually, were generated over a nearly ½ century of distinct economic environments including several business cycles and inflationary periods, an experience long enough to enable forecasts, and
- 3) Commodity industries will likely continue to be net short in order to free capital for higher value projects, which should result in commodity producers continuing to pay an insurance premium to CF investors in order to hedge the price on a fraction of their production.

Wilshire forecasts a 5.5% CF annual return, which consists of 2.5% inflation plus 3.0% for the combined roll and rebalancing returns.¹ This puts Wilshire's forecast CF returns between its forecast equity (8.0%) and bond (5.5%) returns and closer to bond returns.

¹ "Commodity Futures Investing: Is All That Glitters Gold?" Wilshire Associates Inc., March 9, 2005, Steven Foresti and Thomas Toth, p.17

CF Return Forecast. We apply Wilshire's building block approach to arrive at a 6.5% forecast return for CFs. The two primary CF return categories are collateral and futures.

Collateral is assumed to be invested in T-bills and the two collateral return blocks are inflation and the T-bill return above inflation.

The futures return consists of three return blocks.

- 1) Expectational variance return is the unmeasurable difference between the expected and realized spot prices. Like Wilshire (p.16), we project this return to be zero since investor over and underforecasts of future spot prices presumably average to zero in the long run.
- 2) Roll return is the insurance premium obtained by the investor on the futures of an individual commodity. Like the equity premium, the roll return is known only ex-post.
- 3) Rebalancing return is the return from periodic rebalancing of weights among the individual CFs (e.g. between gold and wheat)

The CF return blocks are listed below:

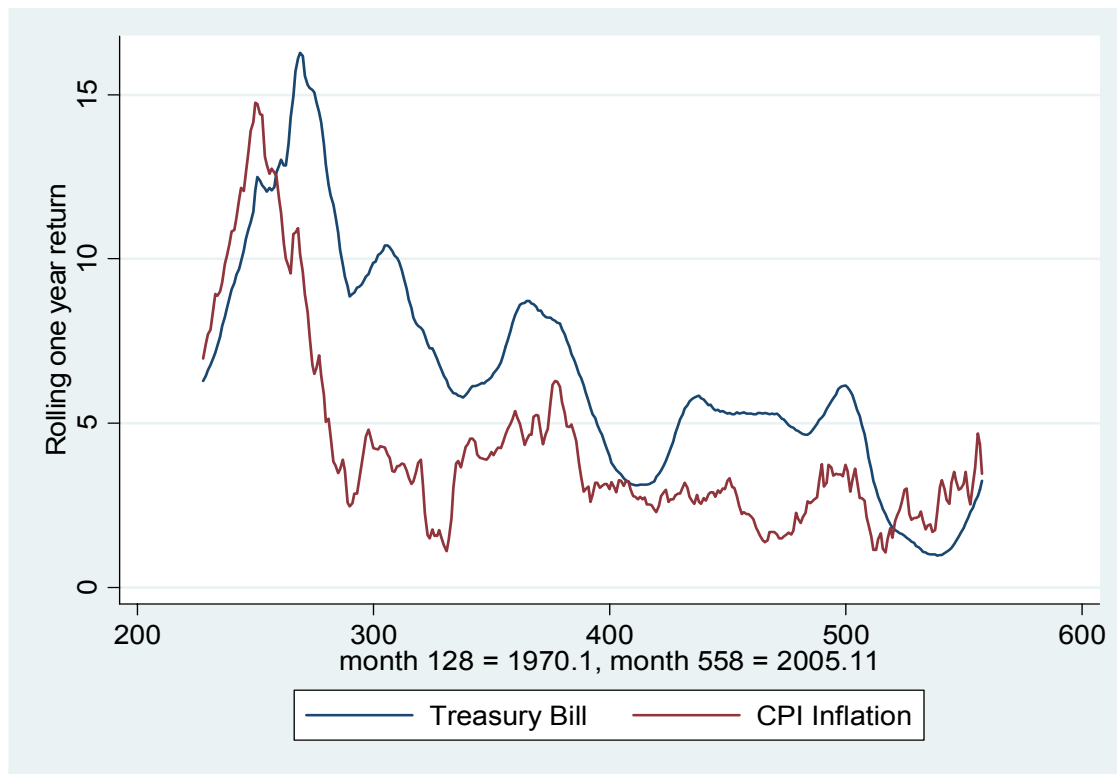
CF Return Component
Collateral (T-bills)
Inflation
Return above inflation
subtotal
Futures
Expectational variance
Roll return
Rebalancing return
subtotal
Total CF return

We adopt Wilshire's inflation forecast of 2.5%, though it is below the long-term mean annual inflation rate of 3.1% since 1926 and 4.7% since 1970.

The other collateral return component is the T-bill return above inflation. Three-month Treasury bill returns have outpaced CPI inflation by 1.7% annually² and over most periods since 1970, as shown below:

The outperformance of T-bill returns over inflation will likely continue long-term. The rationale is that investors demand a T-bill yield above inflation unless the return outlook for other asset classes is unusually unfavorable. In light of the historical 1.7% outperformance of T-bills over inflation, we conservatively project T-bill returns to exceed inflation by 1.0% annually.

² Over the 1970.1 – 2005.11 period, mean annual returns were 6.4% for Treasury bills, 4.7% for CPI inflation, a difference of 1.7% (data sources: Goldman Sachs, Bloomberg, Federal Reserve).



We adopt Wilshire's forecast futures return of 3.0% (roll and rebalancing returns combined). Though the futures return over most periods has exceeded 3%, it seems reasonable to project lower returns in light of growing investor inflows, as discussed in response to question 3.

Historical returns and forecast CF returns are listed below. The only difference between the Wilshire and CalPERS forecast returns is the T-bill return above inflation, as highlighted in bold.

Return Component	Historical (Realized)			Forecast	
	G&R (1959.7 – 2005.11)	GSCI (1970.1 – 2005.11)	DJ-AIG (1991.1 – 2005.11)	Wilshire forecast	CalPERS forecast
Collateral (T-bills)					
Inflation		4.7%	2.6%	2.5%	2.5%
Return above inflation		1.7%	1.4%	0.0%	1.0%
subtotal		6.4%	4.0%	2.5	3.5
Futures return		5.9%	3.6%	3.0%	3.0%
Total CF return	10.5%	12.3%	7.6%	5.5%	6.5%

RISK

Risk summary. Fund risk would be reduced by an investment in CFs

- An investment in CFs reduces:
 - backcast Fund volatility (please see p.4)
 - forecast Fund volatility (pp.5-7)
- CFs have performed well during:
 - equity bear markets (p.8)
 - periods of high inflation (p.9)
- CF returns have been positively skewed (p.10)

Our risk analysis presumes a potential eventual investment in CFs of 3% of the Fund, or \$6 billion. For a discussion of the CF market capacity, please see the response to question 3.

Backcast Fund return and volatility with CFs. We backcast by simulating historical Fund returns with a 3% or 5% investment in CFs. For instance, for a 3% CF investment, the simulated return is as follows:

Simulated return with CFs = 97%*Fund actual return + 3%*CF actual return

Then geometric mean returns and standard deviation of returns are calculated for both actual returns without CFs and for simulated returns with CFs.

The backcast inception is July 1988, the first month CalPERS monthly return data are available. The backcast is performed with two CF indices: the DJAIGCI³ and the GSCI.

For both indices, an investment in CFs would have reduced the volatility of Fund returns. Simulated returns were essentially unchanged, higher with the energy-dominant GSCI, though lower with the more diversified DJAIGCI.

Annualized Returns and Standard Deviations, 1988.7 – 2005.11

<u>Series</u>	<u>Return</u>	<u>change</u>	<u>Stdev.</u>	<u>change</u>
CF DJAIGCI actual	9.78%		19.13%	
CF GSCI actual	12.20%		23.53%	
CalPERS actual	10.62%		15.83%	
<u>CalPERS simulated</u>				
w/ 3% DJAIGCI	10.59%	-0.03%	15.61%	-0.22%
w/ 5% DJAIGCI	10.58%	-0.04%	15.47%	-0.36%
w 3% CF GSCI	10.67%	0.05%	15.59%	-0.24%
w/ 5% CF GSCI	10.70%	0.08%	15.45%	-0.38%

³ DJAIGCI returns prior to January 1991 are unaudited.

Forecast Fund return and volatility with CFs. The forecast return and risk of the CalPERS Fund with different CF allocations (zero, 3%, and 5%) are listed below.

	Commodity Futures Allocation		
	<u>Zero</u>	<u>3%</u>	<u>5%</u>
Fund Return (mean annual) ⁴ change	7.08%	7.06% -0.02%	7.05% -0.03%
Fund Risk (standard deviation) change	11.85%	11.54% -0.31%	11.34% -0.51%

The forecast Fund return is essentially unchanged, while the forecast Fund risk declines 0.3% to 0.5%.

These forecast returns reflect the assumed asset class returns, standard deviations, and correlations listed below. These assumptions are identical to those listed by Wilshire (p.17), except that the forecast CF return is 1.0% higher at 6.5%.

Asset Class Assumptions (source: Wilshire, except CF return)

<u>Asset Class</u>	<u>Return</u>	<u>Risk</u>
US Equity	8.00%	17.00%
Int'l Equity	8.00%	19.00%
Fixed Income	4.75%	5.00%
Real Estate	7.00%	16.00%
Commodity Futures	6.50%	12.00%

	<u>Correlations</u>				
	<u>US Equity</u>	<u>Int'l Equity</u>	<u>Fixed Income</u>	<u>Real Estate</u>	<u>Commodity Futures</u>
US Equity	1.00				
Int'l Equity	0.78	1.00			
Fixed Income	0.29	0.08	1.00		
Real Estate	0.30	0.20	0.15	1.00	
Commodity Futures	0.10	0.04	0.00	0.25	1.00

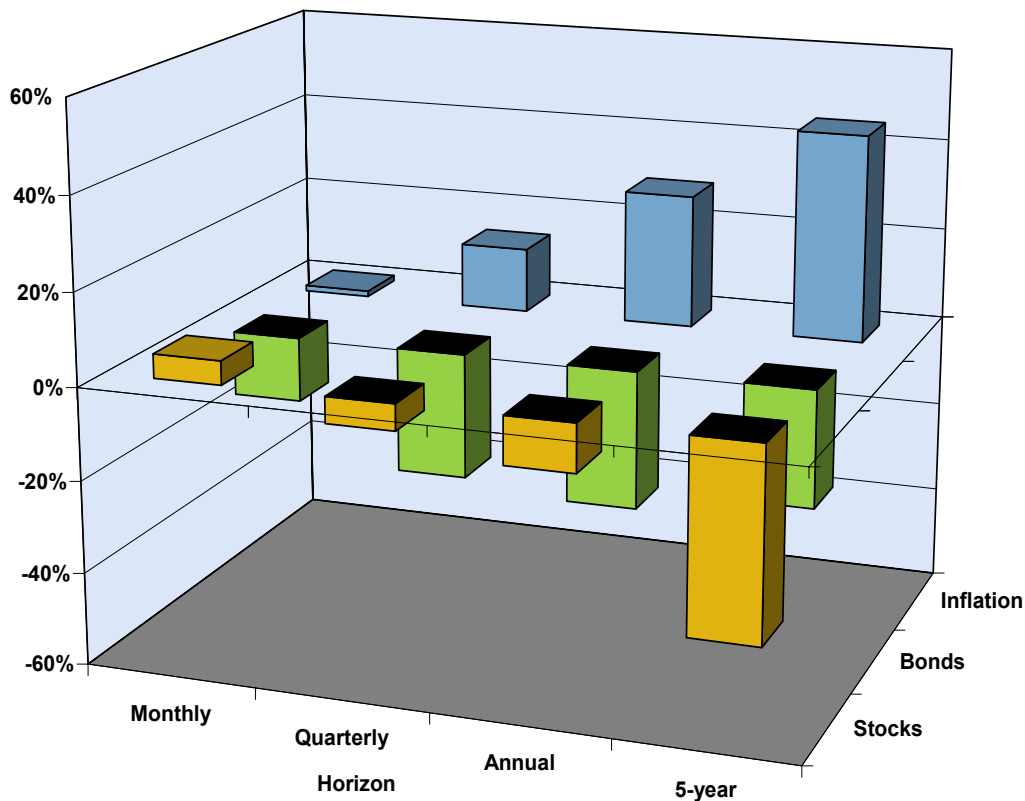
Asset class allocations are assumed to be at policy weights. Private equity was not identified as a separate asset class in Wilshire's CF research paper, and therefore is included in US equity. The investment in CFs is funded pro rata from the other asset classes as listed below:

⁴ A 1% reduction in the forecast CF return (from 6.5% to 5.5%) reduces the forecast Fund return by 3 bp (from 7.06% to 7.03%) for a 3% CF allocation, and by 5 bp (from 7.05% to 7.00%) for a 5% CF allocation.

Fund Asset Allocations

	<u>Current</u>	<u>w/ 3% CFs</u>	<u>w/ 5% CFs</u>
US Equity	46.00%	44.62%	43.70%
Int'l Equity	20.00%	19.40%	19.00%
Fixed Income	26.00%	25.22%	24.70%
Real Estate	8.00%	7.76%	7.60%
Commodity Futures	<u>0.00%</u>	<u>3.00%</u>	<u>5.00%</u>
Total	100.00%	100.00%	100.00%

The decrease in forecast risk is driven by the low correlations of CFs versus stocks and bonds, as illustrated below.⁵



CF returns likely will continue to be weakly correlated with equities and fixed income returns because of their distinct characteristics. A long CF position represents a claim on unanticipated commodity price changes, an equity share

⁵ Gary Gorton and Geert Rouwenhorst, "The Long-term Performance of Commodity Futures" April 4, 2005, slide 8.

represents company ownership and a share in residual cash flows, while a bond represents a claim on debt repayment.

Another difference is the shorter investment horizon of CFs. Since CF contracts usually mature within a few months, CFs are highly sensitive to short-term price fluctuations, while equity and long-bond pricing reflect longer horizons, with less sensitivity to near-term supply and demand conditions. For instance, an unexpected oil price spike or decline tends to have greater effect on CF returns than on equity returns even of oil producers since sharp commodity price changes usually dissipate over time with supply and demand responses.

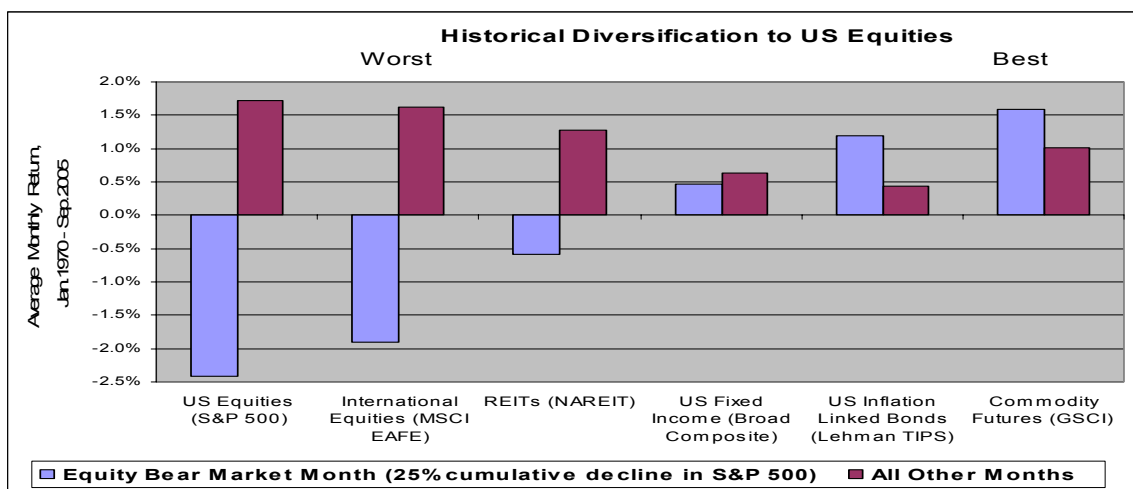
As a result of their distinct characteristics, CFs and financial assets respond differently to evolving economic environments. For instance, commodity supply disruptions and accelerating inflation are generally favorable for CF returns, but adverse for equities and bonds.

Wilshire (p.15) assesses relative asset class performance at different stages of the business cycle and concludes, "In summary it appears that commodity futures react in opposite ways to many economic factors compared to the behavior of equities and bonds. This provides a rationale for the observed low correlations with other asset classes."

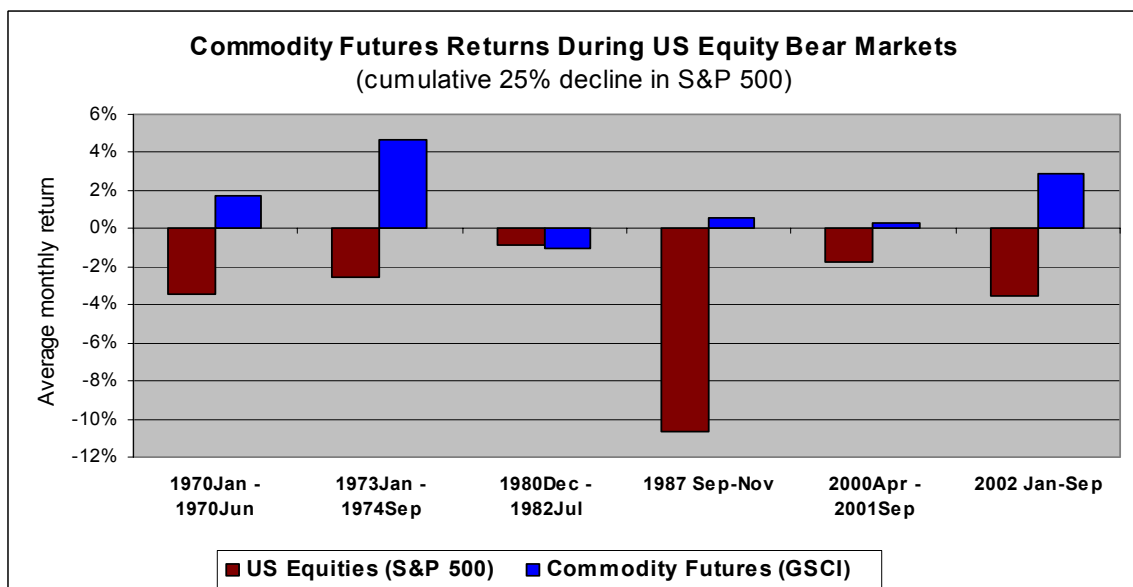
CFs perform well during equity bear markets. The correlation between CF and equity returns is low, but more importantly is low or negative when it is most needed, during equity bear markets.

Since 1970, US equities experienced six bear markets, defined as a period in which cumulative S&P 500 index losses exceeded 25%. During these US equity bear markets:

- Commodity futures had their strongest returns
- Fixed income also provided valuable diversification, but with lower returns and greater vulnerability to interest rate increases
- International equities and REITS (publicly traded real estate) also suffered losses



CFs also were fairly consistent equity diversifiers as CF returns were positive during five of the six equity bear markets since 1970.

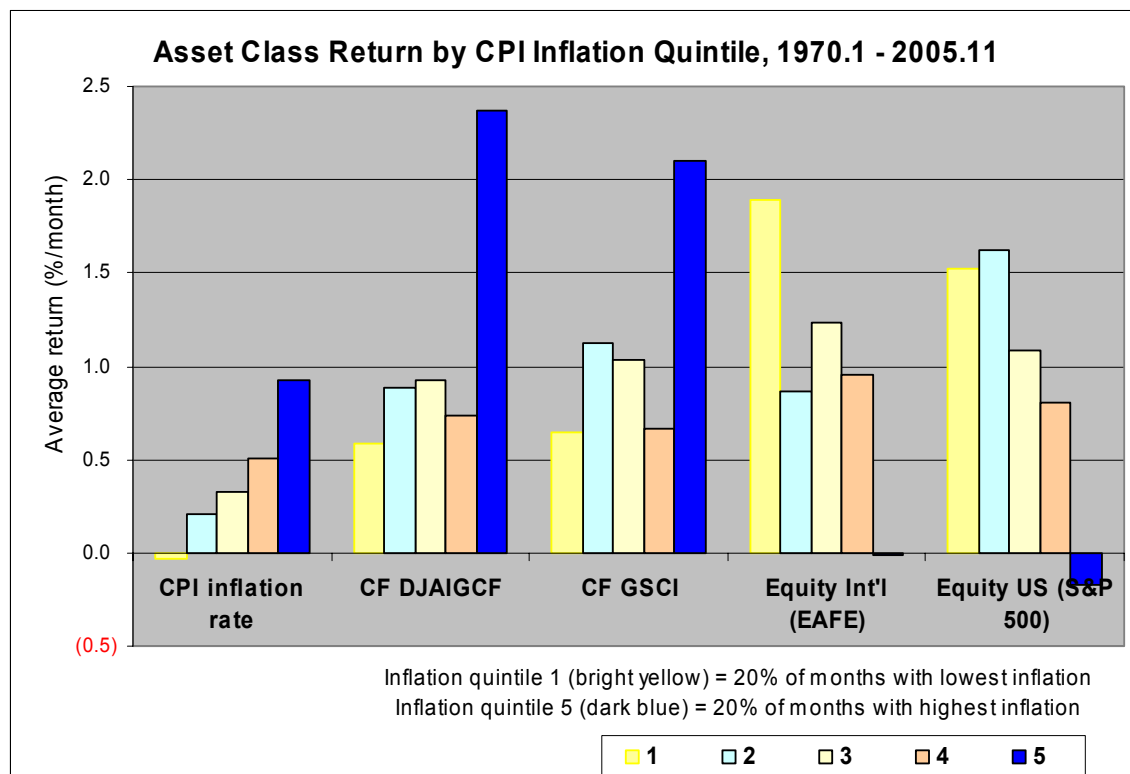


CFs performed well during periods of high inflation. The Fund is equity dominant, as evidenced by equities explaining 90% of Fund volatility and by the +0.89 correlation between Fund and S&P 500 monthly returns since July 1988. Since equities tend to underperform during periods of high inflation, the Fund is vulnerable to high inflation.

Rising inflation and interest rates reduce the present value of expected earnings, pressuring equity valuations lower. High inflation further penalizes equities by raising the effective capital gains tax rate because the capital gains tax is applied to nominal, not real (inflation-adjusted), price appreciation. A higher effective tax rate means that equity prices need to move lower to achieve an equivalent after-tax return.

Unlike equities, CFs returns respond favorably to high inflation as high inflation often coincides with or follows rising spot commodity prices. CF returns and inflation have correlated positively and the positive relation has been stronger over the longer one and five-year horizons, as shown on page 7 above.

For further analysis of asset class returns during distinct inflationary environments, we divide all months since January 1970 into five inflation quintiles. During the 20% of months with the highest inflation (quintile 5 as represented by the dark blue bars in the figure below), strong commodity future returns could have mitigated against negative equity returns.



CF returns have been positively skewed. Unlike equities, the majority of extreme price moves of CFs have been positive.⁶ This positive skewness provides further reason to invest in CFs.

Wilshire question 2

Is it [CFs] superior to anything else CalPERS is doing in terms of diversification (e.g. hedge funds), such that it could supplant something else to avoid over-diversification.

CalPERS response

We see CFs as complementing, rather than replacing, other asset classes or strategies. As Mark notes in his email, the intended purpose of CFs is to provide beta diversification.

With over 90% of Fund assets in stocks and bonds, we feel vulnerable to high inflation and interest rates, an environment favorable for CFs. Given the difficulty in predicting inflation, it seems prudent to hedge against a rise in inflation, especially when doing so has essentially no effect on expected return.

Please see our response to question 1 on the fundamental differences and the historically low correlations between CFs and other Fund asset classes, particularly equities, and the strong CF returns during periods of high inflation and poor equity returns. The distinct return profile of CFs suggest that CFs complement, rather than substitute for, current Fund asset classes.

Wilshire question 3

What is the realistic capacity to which CalPERS could gain exposure, is it sufficiently material enough to be worth pursuing, even if the impact is incremental?

CalPERS response

A small allocation to CFs can be meaningful. Since CFs tend to perform well during equity downturns, a small allocation to CFs can provide a meaningful benefit. The Dutch pension PGGM has invested 4% of its assets in CFs since 2000 and found that:

“Although this 4% is lower than the 20-25% (numerical) optimal allocation that some studies have indicated, it still enabled a substantial reduction in the required contributions. . . . The 4% allocation might seem small, but it

⁶ Gary Gorton and Geert Rouwenhorst, Facts and Fantasies about Commodity Futures, February 2005, p.14; Wilshire, *ibid.*, p.12

shouldn't be sniffed at. . . the amount of risk represented by commodities is comparable to fixed income and real estate although fixed income and real estate have a 39% and 15% allocation in assets respectively." (PGGM, 2005 p.1)

As described in response to question 1, a 3% investment in CFs funded pro rata from other asset classes would reduce Fund expected risk by 31 bp. To put this risk reduction in perspective, a 3% shift in Fund assets from equities to bonds would also reduce Fund risk by 31 bp, but with a detrimental 24 bp reduction in Fund expected return (mean-variance optimization using CalPERS 2004 asset allocation assumptions).

CF markets are large enough to support large pension investments. We are initially proposing a CF pilot program with an investment amount to be determined. For purpose of analysis, we assume a potential eventual CF investment of 3% of Fund assets, or \$6 billion. A 3% potential Fund allocation to CFs is based on the CF investment of other large investors listed below and on the open interest of the CF market.

Pension Plan	Assets (\$B, 12-31-04)	CF Target Weight	CF Target Inv. (\$B)
State Pension			
Massachusetts (MassPRIM)	\$37	2.0%	\$0.7
Missouri (MOSERS)	\$7	2.5%	\$0.2
Pennsylvania	\$27	7.0%	\$1.9
International			
ABP (Netherlands)	\$221	3.0%	\$6.6
Ontario Teachers Pension (Canada)	\$84	3.0%	\$2.5
PGGM (Netherlands)	\$75	5.0%	\$3.8
Endowment			
Harvard University	\$23	13.0%	\$3.0

The CF market is large and liquid and appears to be able to support an additional \$6 billion investment.

Market size of CFs versus other asset classes. We measure the market size of CFs by its open interest comprising exchange traded futures as well as OTC instruments including swaps and structured notes. We are aware that open interest overstates the market size available to institutional investors. For instance the market size for investors could be measured as net industry

exposure. Industry typically is net short, as the demand for price protection from commodity buyers (airlines buying fuel, cereal makers buying wheat) is less than the demand for price protection from commodity sellers (oil and wheat producers). Thus open interest represents an upper bound on the CF investment opportunity.

The futures open interest of individual commodity markets exceeds \$250 billion, with the total market size is two to four times this number if OTC markets are included (Goldman Sachs, August 2005). Using the more conservative OTC multiplier, the CF market size (as proxied by open interest) is approximately \$750 billion, which we next compare to the market size of other asset classes.

Asset Class Market Value*

Asset Class	Value (\$B)
Global Equities (MSCI ACWI)	23,621
Bonds: Int'l govt. + US inv. grade (Citigroup WGBIxUS + SBBIG)	15,305
US Real Estate (Institutional Ownership)**	643
Global Commodity Futures (total open interest – upper bound on market size)	750

* 9-30-05 for real estate, 11-30-05 for the other asset classes

** A year-end 2001 estimate by Prudential (January 2003) was updated to the end of 2005 Q3 by the estimated 18% subsequent capital appreciation in the NCREIF index. As a check, the 9-30-05 market value of NCREIF holdings, which represents an unknown but significant subset of the total institutional real estate holdings, was \$175B (NCREIF.org), while the recent value of the NAREIT (real estate investment trusts) index was \$250 billion. According to Prudential, the value of all commercial real estate is about 10 times that owned by institutional investors, because most companies own their buildings.

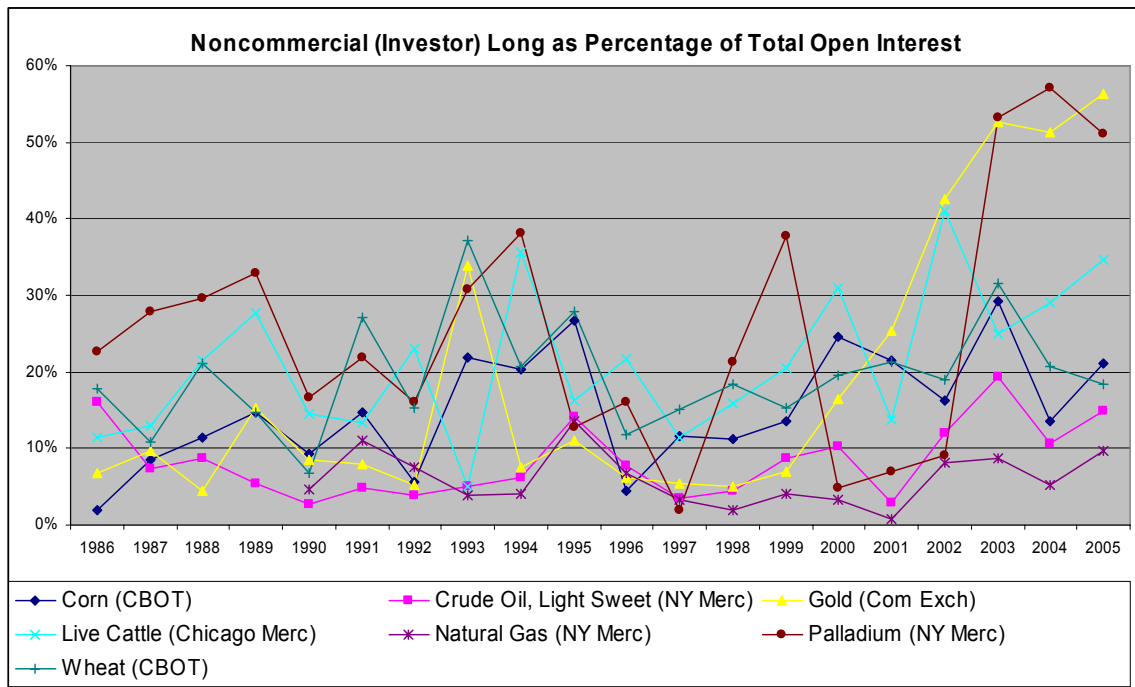
The above figures highlight two points. One is that the CF market size is dwarfed by the publicly-traded equity and fixed income markets, suggesting that these markets will continue to compose the bulk of Fund assets.

The second point is that, subject to an admittedly wide measurement error, the upper bound of the CF market size is similar to the market value of institutionally owned real estate. This suggests that the CF market is large enough to support investments by large pensions.

Further, similar to real estate a few decades ago, the CF markets are still in their infancy for institutional investors, with significant growth potential. CF open interest could expand over time if industry hedges a larger share of production. For instance, the CF open interest (futures and OTC instruments) in energy production is only 6% of the value of annual energy production (Goldman Sachs, May 2005). Strategic investor allocations to CFs provide a reliable long-term source of “insurance” capital that may encourage commodity producers to hedge more.

Measure of investor pressure on expected CF returns. While the capacity of the CF market appears ample today, we are concerned that investor inflows into CFs could diminish its benefits.

We attempt to measure this risk by tracking the noncommercial (investor) share of the total open interest in futures as recorded by the Commodity Futures Trading Commission (CFTC). The idea is that a rise in the investor share of open interest signals that growth in investor inflows exceeds the growth of the total futures market, serving as an early warning indicator of a shrinking insurance premium.



The investor share of long open interest has risen significantly for only two of the selected CFs, gold and palladium. Notably the investor share of open interest has remained low for crude oil and natural gas. Apparently the increased investor inflows into energy futures in recent years has been matched by increased hedging by energy buyers, perhaps because the energy market values are larger (greater capacity making it more difficult for investors to keep pace with the rising demand for hedging) or more volatile (resulting in investors being less willing to take large positions). While we intend to investigate further, the trends in the figure above suggest less risk of diminishing investor returns in energy markets.

Overall, the investor share has been rising, but at a rate of less than 1% annually, as shown below. By this measure, it is not too late to invest in CFs.

Annual Change in Ratio of Investor Long Interest to Total Open Interest, 1986-2005

	(%/year)
Corn (CBOT)	0.7%
Crude Oil, Light Sweet (NY Merc)	0.3%
Gold (Com Exch)	2.1%
Live Cattle (Chicago Merc)	0.8%
Natural Gas (NY Merc)	-0.1%
Palladium (NY Merc)	0.6%
Wheat (CBOT)	0.3%
source: CFTC, CalPERS	

CF Market Volume. Open interest, a measure of market size, can be complemented with volume, the average daily market value of CF trades. Volume is a measure of market depth, an aspect of liquidity. A larger volume lessens the risk of adverse price effects from a certain size trade.

The average 2004 daily traded volume of the 19 commodities in the DJAIGCI was \$32.6 billion (AIG, December 2005). Thus a \$1 billion allocation would be 3.1% of daily trading volume, though this percentage was higher or lower for individual CFs. Since any Fund investment in CFs would be implemented over several days, Fund trades would represent less than 1% of volume. In conclusion, CF market volume is not a barrier for a large pension gaining CF exposure.

Explicit implementation costs. We understand question 3 to be “do the expected benefits exceed the expected costs of investing in CFs given that CFs would likely remain a small percentage of Fund assets?” In our response to question 1, we evaluated the effect of an investment in CFs on Fund risk and return. In this section, we address implementation cost.

For cost estimates we assume implementation via internally managed passive exposure to CFs via total return swaps.

Swap counterparties have indicated CF swap fees of approximately 35 bp (for GSCI, possibly a few basis points higher with the DJAIGCI benchmark) with potential for negotiation. With CalPERS size enhancing negotiation leverage, a 30 bp swap fee is our estimate of the annual explicit implementation cost.

The 30 bp fee to gain beta exposure to CFs is 5 to 20 bp higher than the cost of indexing public-market global stocks and bonds, but is far lower than the cost of gaining exposure to real estate or private equity.

The other cost is internal staff time. Other pensions (Ontario Teachers and PGGM) have indicated that staff time is not significant if implementation is passive exposure via total return swaps, particularly after ISDA agreements are signed. CalPERS currently has ISDA agreements in place with AIG, Barclays Capital, Deutsche Bank, J Aron & Company (the commodities division of Goldman Sachs), JP Morgan, and Morgan Stanley.

In conclusion, implementation costs appear to be only slightly higher for CFs versus public market equity and debt.

Wilshire question 4

If lowering risk through commodities allows CalPERS to take more risk elsewhere, but the "elsewhere" is so capacity constrained that CalPERS can't take that advantage (i.e. an investment in commodities allows CalPERS to increase its allocation to AIM, but AIM can't increase its allocation because its getting more cash back than it can put out in investments), then what is the realistic implications of that?

CalPERS response

If CalPERS is unable to increase risk elsewhere, then per the response to q.1, the implication is that CFs would reduce expected risk with essentially no effect on expected return.

If CalPERS is able to increase risk elsewhere in pursuit of higher returns, which Mark suggests could be achieved in global equities or fixed income, then adding CFs increases expected return with no effect on total Fund risk.